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Assistant Commissioner for Patents
Washington, D.C. 20231

On September 7, 2000

TOWNSEND and TOWNSEND and CREW LLP

By: Andrea [signature]

PATENT
Docket No.: AM-2119/T21300
TTC No.: 16301M-021300US

OIPE JC137
SEP 12 2000
PATENT & TRADEMARK OFFICE

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of:

Karl Littau, et al.

Application No.: 08/893,917

Filed: July 11, 1997

For: Remote Plasma Cleaning Source Having Reduced Reactivity With a Substrate Processing Chamber

Examiner: Rudy Zervigon

Art Unit: 1763

TRANSMITTAL TO APPEAL BRIEF UNDER 37 CFR § 1.192

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Assistant Commissioner for Patents
Washington, D.C. 20231

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Sir:

Applicants hereby submit an Appealant's Brief Under 37 CFR § 1.192for filing with the United States Patent and Trademark Office.

The Commissioner is authorized to charge the fee of $300.00 for the submission of the Brief, and is further authorized to charge any additional fees or credit overpayment to the our Deposit Account No. 20-1430.

Respectfully submitted,

[signature]

Chun-Pok Leung
Reg. No. 41,405

TOWNSEND and TOWNSEND and CREW LLP
Tel: 415-576-0200
Fax: 415-576-0300

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On September 7, 2000

TOWNSEND and TOWNSEND and CREW LLP

By: Andrew Ho

PATENT
Attorney Docket No.: AM2119/T21300
TTC No.: 16301M-021300

OIPE JC137
SEP 12 2000
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**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES**

In re application of:	Examiner: Rudy Zervigon
Karl Littau et al.	Art Unit: 1763
Application No.: 08/893,917	APPELLANT'S BRIEF UNDER 37 CFR § 1.192
Filed: July 11, 1997	
For: REMOTE PLASMA CLEANING SOURCE HAVING REDUCED REACTIVITY WITH A SUBSTRATE PROCESSING CHAMBER	

Assistant Commissioner for Patents
Washington, D.C. 20231

Sir:

Applicants, in the above-captioned patent application, appeal the final rejection of claims 1-21. The claims on appeal have been finally rejected pursuant to MPEP § 706.07(b). Accordingly, this appeal is believed to be proper. This appeal brief is filed in triplicate.

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I. REAL PARTY IN INTEREST:

The real party in interest for the above-identified application is APPLIED MATERIALS, INC., a Delaware corporation having its principal place of business at P.O. Box 450A, Santa Clara, California 95052. The assignment is recorded in the U.S. Patent and Trademark Office on January 30, 1998 at Reel 8947/Frame 0642.

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II. RELATED APPEALS AND INTERFERENCES:

There are no appeals or interferences related to the present appeal.

III. STATUS OF CLAIMS:

Claims 1-21 are pending. Claims 1-4, 6, 8, 9, 11-15, and 21 stand rejected under 35 U.S.C. § 102(b) as being anticipated by Kawamura (U.S. Patent No. 5,328,558). Claims 1-15 and 21 stand rejected under 35 U.S.C. § 102(b) as being anticipated by Moslehi (U.S. Patent No. 5,403,434). Claims 16-20 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Kawamura or Moslehi in view of Stevens et al. (U.S. Patent No. 5,302,803). Claims 1-21 are the subject of this appeal.

IV. STATUS OF AMENDMENTS:

Claims 1-21 were rejected under 35 U.S.C. § 103(a) upon the grounds set forth in the Final Office Action mailed on March 10, 2000.

Applicants filed an Amendment under 37 C.F.R. § 1.116 on May 4, 2000.

An Advisory Action dated June 2, 2000 indicated that the Amendment filed on May 4, 2000 would be entered upon the filing of an appeal. The Examiner maintained the rejection of all pending claims on the ground that the mixing point of the plasma and nonplasma gases in each of Kawamura and Moslehi is anterior to the wafer processing chamber of each reference.

In accordance with 37 C.F.R. § 1.192(c)(9), a copy of the claims involved in the appeal are contained in the Appendix attached hereto.

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V. SUMMARY OF THE INVENTION:

Embodiments of the present invention provide a method and an apparatus for cleaning a chamber in a substrate processing system that is less destructive to the chamber walls and the components contained therein, while increasing the number of wafers that may be processed between wet cleans. This is accomplished by mixing a nonplasma diluent gas with a flow of reactive radicals produced by a plasma remotely disposed with respect to the chamber, at a point anterior to the chamber. For example, the mixing may occur at a location between a plasma applicator and the chamber. This produces a gas-radical mixture which allows increasing the flow rate of a gas through the chamber, while decreasing the rate at

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which materials located within the chamber are etched by the reactive radicals dispersed within the gas-radical mixture.

According to an embodiment of the present invention, a method of removing residue from a chamber includes forming a plasma remotely with respect to the chamber; forming, from the plasma, a flow of reactive radicals traversing toward a substrate processing chamber; and forming a nonplasma diluent gas flow. The flow of reactive radicals is intermixed with the nonplasma diluent gas flow, anterior to the substrate processing chamber, to form a gas-radical mixture. Thereafter, the gas-radical mixture is flowed into the substrate processing chamber, with the chamber maintained at processing conditions suitable for reactions with the reactive radicals to occur.

In accordance with another embodiment of the invention, an apparatus includes a processing chamber and a plasma source having a conductive plasma applicator defining an internal volume. The apparatus further includes a fluid manifold having multiple inlets and an outlet which is coupled to an intake port of the chamber. One of the inlets is in fluid communication with the plasma applicator, with the remaining inlets being in fluid communication with a supply of nonplasma diluent gas. In this fashion, the diluent gas flow and the flow of reactive radicals mix when traveling between the inlets and the outlet to form a gas-radical mixture egressing from the outlet and traversing through the intake port.

VI. ISSUES:

The following issues are presented:

Whether claims 1-4, 6, 8, 9, 11-15, and 21 are properly rejected under 35 U.S.C. § 102(b) as being anticipated by Kawamura.

Whether claims 1-15 and 21 are properly rejected under 35 U.S.C. § 102(b) as being anticipated by Moslehi.

Whether claims 16-20 are properly rejected under 35 U.S.C. § 103(a) as being unpatentable over Kawamura or Moslehi in view of Stevens et al.

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VII. GROUPING OF THE CLAIMS:

In the present case, the rejected claims do not all stand or fall together. Applicants submit that each claim presents distinct issues concerning patentability. In the

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interest of administrative economy and efficiency, however, Applicants agree to narrow the issues for the purposes of this appeal only by grouping the claims as follows:

Group 1: Claims 1-3 and 6, which relate generally to a method of removing residue from a substrate processing chamber, wherein the method mixes a flow of reactive radicals and a nonplasma diluent gas flow anterior to the chamber to form a gas-radical mixture, and flows the gas-radical mixture into the chamber;

Group 2: Claim 4, which is directed generally to the same subject matter as claim 1, but which includes the additional limitation that the nonplasma diluent gas flow comprises an inert gas;

Group 3: Claim 5, which is directed generally to the same subject matter as claim 1, but which includes the additional limitation that the nonplasma diluent gas flow comprises a reduction gas;

Group 4: Claim 7, which is directed generally to the same subject matter as claim 1, but which includes the additional limitation that the rate of the nonplasma diluent gas flow and the rate of the flow of reactive radicals have a ratio of at least 2:1;

Group 5: Claims 8, 12, and 13, which relate generally to a substrate processing apparatus having a process chamber, wherein the apparatus includes means for mixing a flow of reactive radicals and a nonplasma diluent gas flow downstream of the means for forming a plasma and anterior to the chamber to form a gas-radical mixture;

Group 6: Claims 9, 14, and 15, which are directed generally to the same subject matter as claim 8, but which include the additional limitation that the nonplasma diluent gas comprises a nonplasma inert gas;

Group 7: Claim 10, which is directed generally to the same subject matter as claim 8, but which includes the additional limitation that the rate of the nonplasma diluent gas flow and the rate of the flow of reactive radicals have a ratio of at least 2:1;

Group 8: Claim 11, which is directed generally to the same subject matter as claim 8, but which includes the additional limitation that the nonplasma diluent gas comprises a reduction gas;

Group 9: Claims 16-20, which relate generally to a substrate processing apparatus, wherein the apparatus includes a plasma applicator defining an internal volume which has an input aperture and an output aperture equipped with microwave arrestors, and wherein a pump system directs a nonplasma diluent gas flow and a flow of reactive radicals for mixing when traveling between the inlets and the outlet of a mixing manifold to form a gas-radical mixture egressing from the outlet of the mixing manifold and traversing through an intake port of a process chamber; and

Group 10: Claim 21, which relates generally to a method of removing residue from a substrate processing chamber, wherein the method mixes a flow of reactive radicals and a nonplasma gas flow anterior to the chamber to form a gas-radical mixture, and flows the gas-radical mixture into the chamber.

VIII. DISCUSSION OF THE REFERENCES RELIED UPON BY THE EXAMINER:

In rejecting the claims under 35 U.S.C. §§ 102(b) and 103(a), the Examiner relied upon the following references:

1. Kawamura (United States Patent No. 5,328,558)

Kawamura discloses a method for etching an SiO_2 film by flowing plasma-activated species of an NF_3/H_2 mixture as a feed gas for an etchant for etching SiO_2 on a silicon wafer. "The NF_3/H_2 mixed ratio of the mixture is so set as not to effect the etching of the SiO_2 film under a chemical action. **Then** the absorbed activated species are irradiated with Ar low energy ions so that the activated species are excited and etch the SiO_2 film." Abstract (emphasis added). The NF_3/H_2 is activated by plasma to produce activated F^*, H^*, and N^* species which are flowed into the chamber. The flow is stopped by closing valves 36 and 38, and then the valve 50 for the Ar gas is opened to feed the Ar gas into the chamber. "The Ar gas is made into plasma by the high-frequency power source 56 and magnet coil 58" to excite the activated F^*, H^*, and N^* species absorbed in the SiO_2 film (col. 6, lines 12-36). There is no mixing of a flow of reactive radicals and a nonplasma gas flow anterior of the chamber.

In Kawamura, the pipe 32 is used to introduce "activated species, under a plasma excitation condition, into the chamber 10" (col. 3, lines 51-53), and the pipe 34 is used to introduce "Ar in a plasma phase or Ar ions in a plasma into the chamber 10" (col. 3, lines

59-60). There is no means for mixing a flow of reactive radicals and a nonplasma diluent gas flow anterior of the chamber to form a gas-radical mixture.

2. Moslehi (United States Patent No. 5,403,434)

Moslehi discloses a digermane-assisted dry cleaning process. For thermal activation, "[t]he halogen-containing gas additive, such as HCl or HBr, is introduced into the basic cleaning mixture of $Ge_2H_6 + H_2$ through nonplasma gas manifold 22 (without any direct plasma discharge activation)" (col. 10, lines 53-56). For a plasma process, the "plasma activation can be achieved by injecting a remote plasma stream using the gases injected through plasma gas manifold 24" (col. 11, lines 29-31). Moslehi injects "a remote plasma stream of H_2, Ar/He (or other inert gas such as He or Xe), or an H_2+Ar/He mixture" (col. 11, lines 37-39). "[W]hile some or all of the digermane gas and the HCl/HBr and HF additives can also be introduced in the plasma stream, these components of the cleaning process stream are introduced as downstream non-plasma gases" (col. 11, lines 40-44). Moslehi directs the "nonplasma cleaning process gas stream into the afterglow of the plasma discharge inside the process chamber" (col. 12, lines 1-3). The inert gas plasma streams "interact with the non-plasma injected gas molecules, exciting them and causing process activation" (col. 11, lines 62-65).

Moslehi does not teach mixing a nonplasma gas flow with a flow of reactive radicals to form a gas-radical mixture anterior to the chamber. Instead, Moslehi discloses either introducing digermane gas and additives with inert gases in a remote plasma stream through the plasma gas tube 24 into the chamber, or using an inert gas plasma through the plasma gas tube 24 to excite downstream non-plasma digermane gas and additives introduced via the nonplasma gas manifold 22 into the afterglow of the plasma discharge of the plasma gas tube 24 in the chamber (col. 11, lines 37-44). Either both the digermane gas and additives and the inert gases flow through the plasma gas tube to produce a remote plasma stream of the gases into the chamber, or the non-plasma digermane gas and additives are introduced into the afterglow of the inert gas plasma discharge in the chamber. In each case, there is no mixing of a nonplasma gas flow and a flow of reactive radicals to form a gas-radical mixture anterior to the chamber.

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The "nonplasma gas manifold 22" is used to introduce nonplasma gases into the chamber (col. 11, lines 7-9). For a plasma process, "plasma activation can be achieved by injecting a remote plasma stream using the gases injected through plasma gas manifold 24" (col. 11, lines 29-32). As shown in Fig. 1, the nonplasma gas manifold 22 and the plasma gas manifold 24 have separate injectors into the chamber.

3. Stevens et al. (United States Patent No. 5,302,803)

Stevens et al. discloses a microwave plasma apparatus using a predetermined proportion of relative power between a TE_{11} mode and a TM_{01} mode to produce radial uniformity of the plasma. A microwave coupler transforms microwave energy from a microwave source into approximately equal proportions of TE_{11} and TM_{01} modes. The coupler includes a first arm for generating the TE_{11} mode and a second arm for generating the TM_{01} mode which are then combined in a cylindrical waveguide section having a sufficient inner diameter to support propagation of both modes.

IX. ARGUMENTS:

Because all the claims do not stand or fall together, Applicants will present arguments for each claim group.

Claim Group 1

Claims 1-3 stand rejected under 35 U.S.C. § 102(b) as being anticipated by Kawamura and under 35 U.S.C. § 102(b) as being anticipated by Moslehi. The Examiner alleges that the mixing point of the plasma and nonplasma gases in each of Kawamura and Moslehi is anterior to the wafer processing chamber.

Claim 1, from which claims 2 and 3 depend, recites a method of removing residue from a substrate processing chamber. The method includes mixing a flow of reactive radicals and a nonplasma diluent gas flow anterior to the chamber to form a gas-radical mixture, and flowing the gas-radical mixture into the chamber.

Applicants respectfully assert that claims 1-3 are novel and patentable over Kawamura and Moslehi because, for instance, they do not disclose or suggest mixing a flow of reactive radicals and a nonplasma diluent gas flow anterior to a chamber to form a gas-radical mixture, and flowing the gas-radical mixture into the chamber in a method of removing residue from a substrate processing chamber, as recited in claim 1 from which claims 2 and 3 depend.

Claim copy

In Kawamura, the NF_3/H_2 is activated by plasma to produce activated F^*, H^*, and N^* species which are flowed into the chamber. The flow of the plasma activated species is stopped by closing valves 36 and 38, and then the valve 50 for the Ar gas is opened to feed the Ar gas into the chamber. There is no mixing of a flow of reactive radicals and a nonplasma diluent gas flow anterior of the chamber to form a gas-radical mixture.

In Moslehi, either both the digermane gas and additives and the inert gases flow through the plasma gas tube to produce a remote plasma stream of the gases into the chamber, or the non-plasma digermane gas and additives are introduced into the afterglow of the inert gas plasma discharge in the chamber. In each case, there is no mixing of a nonplasma diluent gas flow and a flow of reactive radicals to form a gas-radical mixture anterior to the chamber.

Claim Group 2

Claim 4 stands rejected on the same grounds as claim 1 from which claim 4 depends. Applicants believe that claim 4 is allowable for the same reasons that claim 1 is allowable. Further, claim 4 recites that the nonplasma diluent gas flow comprises an inert gas. In Kawamura, the Ar gas is not mixed with the plasma-activated species anterior of the chamber to form a gas-radical mixture. In Moslehi, the inert gases are plasma-activated with the digermane gas and additives and flowed into the chamber in one case, and are plasma-activated and flowed into the chamber separately from the nonplasma digermane gas and additives in the other case. There is no mixing of a nonplasma inert gas with reactive radicals to form a gas-radical mixture anterior of the chamber.

SAME

Same

Claim Group 3

Claim 5 stands rejected under 35 U.S.C. § 102(b) as being anticipated by Moslehi. Applicants believe that claim 5 is allowable for the same reasons that claim 1 is allowable. Further, claim 5 recites that the nonplasma diluent gas flow comprises a reduction gas. In Moslehi, H_2 is plasma-activated with the remaining gases and flowed into the chamber in one case, and is introduced into the chamber separately from the plasma-activated inert gases. There is no mixing of a nonplasma reduction gas with reactive radicals to form a gas-radical mixture anterior of the chamber.

NO

NO

Claim Group 4

Claim 7 stands rejected under 35 U.S.C. § 102(b) as being anticipated by Moslehi. Applicants believe that claim 7 is allowable for the same reasons that claim 1 is allowable. Further, claim 7 recites that the rate of the nonplasma diluent gas flow and the rate of the flow of plasma-activated reactive radicals have a ratio of at least 2:1. The Examiner alleges that Moslehi at column 10, line 53-59 discloses this limitation. Applicants note, however, that the cited section in Moslehi describes the use of a digermane gas with halogen-containing gas additives "through nonplasma gas manifold 22 (without any direct plasma discharge activation)" (col. 10, lines 55-51). Therefore, not only does Moslehi fail to disclose mixing a flow of reactive radicals and a nonplasma diluent gas flow anterior to the chamber to form a gas-radical mixture, but it does not teach or suggest the recited flow rate between the nonplasma diluent gas flow and the flow of plasma-activated reactive radicals.

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Claim Group 5

Claims 8, 12, and 13 stand rejected under 35 U.S.C. § 102(b) as being anticipated by Kawamura and under 35 U.S.C. § 102(b) as being anticipated by Moslehi. The Examiner alleges that the mixing point of the plasma and nonplasma gases in each of Kawamura and Moslehi is anterior to the wafer processing chamber.

Claim 8, from which claims 12 and 13 depend, recites a substrate processing apparatus which includes a process chamber, means for mixing a flow of reactive radicals and a nonplasma diluent gas flow downstream of the means for forming a plasma and anterior to the chamber to form a gas-radical mixture, and means for flowing the gas-radical mixture into the chamber.

Applicants respectfully assert that claims 8, 12, and 13 are novel and patentable over Kawamura and Moslehi because, for instance, they do not disclose or suggest means for mixing a flow of reactive radicals and a nonplasma diluent gas flow anterior to a chamber to form a gas-radical mixture, and means for flowing the gas-radical mixture into the chamber, as recited in claim 8 from which claims 12 and 13 depend.

SAME as above.

In Kawamura, a pipe 32 is used to introduce "activated species, under a plasma excitation condition, into the chamber 10" (col. 3, lines 51-53), and a separate pipe 34 is used to introduce "Ar in a plasma phase or Ar ions in a plasma into the chamber 10" (col. 3, lines

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59-60). There is no means for mixing a flow of reactive radicals and a nonplasma diluent gas flow anterior of the chamber to form a gas-radical mixture.

In Moslehi, the "nonplasma gas manifold 22" is used to introduce nonplasma gases into the chamber (col. 11, lines 7-9). For a plasma process, "plasma activation can be achieved by injecting a remote plasma stream using the gases injected through plasma gas manifold 24" (col. 11, lines 29-32). As shown in Fig. 1, the nonplasma gas manifold 22 and the plasma gas manifold 24 have separate injectors into the chamber. Thus, there is no means for mixing a nonplasma diluent gas flow and a flow of reactive radicals to form a gas-radical mixture anterior to the chamber.

Claim Group 6

Claims 9, 14, and 15 stand rejected on the same grounds as claim 8 from which claims 9, 14, and 15 depend. Applicants believe that claims 9, 14, and 15 are allowable for the same reasons that claim 8 is allowable. Further, claim 9 from which claims 14 and 15 depend recites that the nonplasma diluent gas flow comprises a nonplasma inert gas. In Kawamura, the Ar gas is not mixed with the plasma-activated species anterior of the chamber to form a gas-radical mixture. In Moslehi, the inert gases are plasma-activated with the digermane gas and additives and flowed into the chamber in one case, and are plasma-activated and flowed into the chamber separately from the nonplasma digermane gas and additives in the other case. There is no mixing of a nonplasma inert gas with reactive radicals to form a gas-radical mixture anterior of the chamber.

SAME

Claim Group 7

Claim 10 stands rejected under 35 U.S.C. § 102(b) as being anticipated by Moslehi. Applicants believe that claim 10 is allowable for the same reasons that claim 8 is allowable. Further, claim 10 recites that the rate of the nonplasma diluent gas flow and the rate of the flow of plasma-activated reactive radicals have a ratio of at least 2:1. The Examiner alleges that Moslehi at column 10, line 53-59 discloses this limitation. Applicants note, however, that the cited section in Moslehi describes the use of a digermane gas with halogen-containing gas additives "through nonplasma gas manifold 22 (without any direct plasma discharge activation)" (col. 10, lines 55-51). Therefore, not only does Moslehi fail to disclose mixing a flow of reactive radicals and a nonplasma diluent gas flow anterior to the chamber to

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form a gas-radical mixture, but it does not teach or suggest the recited flow rate between the nonplasma diluent gas flow and the flow of plasma-activated reactive radicals.

Claim Group 8

Claim 11 stands rejected under 35 U.S.C. § 102(b) on the same grounds as claim 8 from which claim 11 depends. Applicants believe that claim 11 is allowable for the same reasons that claim 8 is allowable. Further, claim 11 recites that the nonplasma diluent gas flow comprises a reduction gas. Kawamura uses plasma-activated H^* species, not a nonplasma reduction gas. In Moslehi, H_2 is plasma-activated with the remaining gases and flowed into the chamber in one case, and H_2 is introduced into the chamber via a nonplasma manifold separately from the plasma-activated inert gases in the other case. There is no mixing of a nonplasma reduction gas with reactive radicals to form a gas-radical mixture anterior of the chamber.

Claim Group 9

Claims 16-20 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Kawamura or Moslehi in view of Stevens et al. The Examiner alleges that Kawamura or Moslehi discloses everything in claims 16-20 except for the microwave arrestors and apertures, and alleges that Stevens et al. discloses a microwave applicator using both an input aperture and output aperture with microwave arrestors at column 9, lines 24-32.

Claim 16, from which claims 17-20 depend, recites a substrate processing apparatus which includes a plasma applicator defining an internal volume which has an input aperture and an output aperture equipped with microwave arrestors, and a pump system which directs a nonplasma diluent gas flow and a flow of reactive radicals for mixing when traveling between the inlets and the outlet of a mixing manifold to form a gas-radical mixture egressing from the outlet of the mixing manifold and traversing through an intake port of a process chamber.

Applicants respectfully assert that claims 16-20 are patentable over the cited references because, for instance, they fail to disclose or suggest a mixing manifold and a pump system to create a nonplasma diluent gas flow and a flow of the reactive radicals to the mixing manifold to combine the diluent gas flow and the flow of the reactive radicals to form a gas-

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radical mixture egressing from the outlet of the mixing manifold and traversing through the intake port of the chamber, as recited in claim 16 from which claims 17-20 depend.

As discussed above, Kawamura does not teach a mixing manifold for mixing a nonplasma diluent gas flow and a flow of reactive radicals, but discloses separately flowing activated species of NF_3/H_2 first and then an Ar gas into the chamber. In Kawamura, the pipe 32 is used to introduce "activated species, under a plasma excitation condition, into the chamber 10" (col. 3, lines 51-53), and the pipe 34 is used to introduce "Ar in a plasma phase or Ar ions in a plasma into the chamber 10" (col. 3, lines 59-60). In Moslehi, the "nonplasma gas manifold 22" is used to introduce nonplasma gases into the chamber (col. 11, lines 7-9), and "plasma activation can be achieved by injecting a remote plasma stream using the gases injected through plasma gas manifold 24" (col. 11, lines 29-32). As shown in Fig. 1, the nonplasma gas manifold 22 and the plasma gas manifold 24 have separate injectors into the chamber. Thus, there is no mixing manifold and a pump system to combine the diluent gas flow and the flow of the reactive radicals to form a gas-radical mixture egressing from the outlet of the mixing manifold and traversing through the intake port of the chamber. Applicants further note that Stevens et al. does not teach the microwave applicator and apertures at column 9, lines 24-32 as alleged by the Examiner.

matches

Claim Group 10

Claim 21 stands rejected under 35 U.S.C. § 102(b) as being anticipated by Kawamura and under 35 U.S.C. § 102(b) as being anticipated by Moslehi. The Examiner alleges that the mixing point of the plasma and nonplasma gases in each of Kawamura and Moslehi is anterior to the wafer processing chamber.

same

Claim 21 recites a method of removing residue from a substrate processing chamber. The method includes mixing a flow of reactive radicals and a nonplasma gas flow anterior to the chamber to form a gas-radical mixture, and flowing the gas-radical mixture into the chamber.

Applicants respectfully assert that claim 21 is novel and patentable over Kawamura and Moslehi because, for instance, they do not disclose or suggest mixing a flow of reactive radicals and a nonplasma gas flow anterior to a chamber to form a gas-radical mixture,

same

and flowing the gas-radical mixture into the chamber in a method of removing residue from a substrate processing chamber.

As discussed above, Kawamura discloses flowing plasma-activated F^*, H^*, and N^* species into the chamber, stopping the flow, and then feeding Ar gas into the chamber. There is no mixing of a flow of reactive radicals and a nonplasma gas flow anterior of the chamber to form a gas-radical mixture. In Moslehi, either both the digermane gas and additives and the inert gases flow through the plasma gas tube to produce a remote plasma stream of the gases into the chamber, or the non-plasma digermane gas and additives are introduced into the afterglow of the inert gas plasma discharge in the chamber. In each case, there is no mixing of a nonplasma gas flow and a flow of reactive radicals to form a gas-radical mixture anterior to the chamber. Therefore, claim 21 is novel and patentable over Kawamura and Moslehi.

X. CONCLUSION:

In view of the foregoing arguments distinguishing claims 1-21 over the art of record, Applicants respectfully submit that the claims are in condition for allowance, and respectfully request that the rejection of these claims be reversed.

Respectfully submitted,

Chun-Pok Leung
Reg. No. 41,405

TOWNSEND and TOWNSEND and CREW LLP
Tel: (415) 576-0200
Fax: (415) 576-0300
RL
PA 3089383 v1

Encl.: Appendix of claims involved in appeal